REMARKS

This is in response to the Office Action dated January 16, 2004. Claims 1-15 are pending.

General

For purposes of example, and without limitation, certain example embodiments of this invention relate to a method of making a contact hole (or via) in a multi-layer insulating film. Referring to Figs. 1-2 of the instant application for example, a semiconductor substrate (conductive layer) is provided having a device isolation region 102 and a diffusion layer 103. A first dielectric film (e.g., silicon nitride) 104 is deposited on the substrate, and thereafter second and third dielectric films (e.g., silicon oxide and/or silicon oxynitride) 105 and 106 are formed on the substrate over the first film 104 (see Figs. 1(c) to 1(d)). A resist or mask 107 is then formed on the substrate and used for etching an aperture in layers 105 and 106 (see Fig. 1(d)). The etching of layers 105-106 causes a reaction product 108 to form on an exposed portion of underlying layer 104. This byproduct 108 is then removed in a second etching step using *oxygen (O) inclusive gas that is free of fluorine (F)* (see Fig. 2(e)). Thereafter, in a third etching step, another gas is used to etch an aperture in silicon nitride layer 104, which again causes another reaction product 109 to form on an exposed portion of underlying semiconductor substrate 101 (see Fig. 2(f)). A fourth etching step using an *oxygen (O) inclusive gas free of fluorine (F)* is then used to remove reaction product 109 to expose the semiconductor substrate 101 in the contact hole or via, and thereafter the resist 107 is removed (see Fig.

2(g)). The undesirable reaction products 108, 109 are formed as a result of *fluoro*carbon reactions during the etching. To remove these undesirable *fluoro*carbon reaction products 108, 109, oxygen inclusive gas is used which is *free of F* (e.g., pg. 14, line 25 to pg. 15, line 8).

Section 112 Rejection

Regarding the Section 112 rejection in paragraph 1 of the Office Action, the claims have been amended as suggested by the Examiner to call for gas "consisting essentially of" oxygen. As will be explained below, this change overcomes both the Section 112 and Section 102/103 rejections, because the "consisting essentially of" language excludes the undesirable F gas required in the cited art.

Art Rejections

Claim 1 stands rejected under 35 U.S.C. Section 102(e) as being allegedly anticipated by Ou-Yang. This Section 102(e) rejection is respectfully traversed for at least the following reasons.

Claim 1 as amended requires ". . . . a second step of removing a reaction product deposited on the first film through the first step with a second etching gas which consists essentially of O_2 to expose the first film; a third step of etching the first film exposed through the second step with a third etching gas until the conductive layer is exposed; and a fourth step of removing a reaction product deposited on the conductive layer through the third step with a fourth etching gas which consists essentially of O_2 thereby forming a concave portion penetrating the first and second films to reach the conductive layer

surface. As explained above, for example, undesirable reaction products 108, 109 are formed as a result of *fluoro*carbon reactions during the etching. To remove these undesirable *fluoro*carbon reaction products 108, 109, oxygen inclusive gas is used which is *free of F* is used in certain embodiments (e.g., pg. 14, line 25 to pg. 15, line 8).

Claim 1 as amended requires that the second and fourth etching gases *consist essentially* of oxygen. The phrase "consists essentially of" excludes other "material" elements such as F from the gas. Since F is a material element, the phrase "consists essentially of" excludes it from the second and fourth gases recited in claim 1. As explained above, excluding significant F from the oxygen based glass is highly advantageous in that undesirable *fluoro*carbon reaction products 108, 109 can be removed in a more efficient and improved manner (e.g., pg. 14, line 25 to pg. 15, line 8).

Ou-Yang discloses a method of making a circuit device wherein metallic Al (aluminum) layer 52, TiN or SiON (silicon oxynitride) layer 54, and dielectric (e.g., SiO_2) layer 56 are formed on semiconductor substrate 50 (e.g., col. 6, lines 5-11 and 26-31). Resist 58 is used to etch a hole in dielectric layer 56 thereby forming byproduct 62 in the etched hole as best shown in Fig. 7. Thereafter, a flushing step using oxygen-based plasma is performed to flush out fluorine species remaining in the chamber (e.g., col. 6, line 62 to col. 7, line 8). Then, Ou-Yang uses a treatment with *fluorocarbon* gas to remove byproduct 62 (e.g., col. 7, lines 32-60). Thus, it can be seen that Ou-Yang significantly differs from the invention of claim 1 since Ou-Yang uses a fluorocarbon gas

such as CHF_3 (having significant amounts of undesirable F) in order to remove the undesirable byproduct 62 (e.g., col. 3, lines 41-48; and col. 7, lines 47-50).

In contrast, claim 1 clearly requires that the second and fourth gases consist essentially of O (i.e., excluding F), so that no significant F gas is used during removal of the reaction products. Oh-Yang's use of highly-F inclusive gas thereby teaches directly away from the invention of claim 1, and is highly undesirable since it may cause additional undesirable fluorocarbon byproducts to form which the invention of claim 1 seeks to avoid. Thus, it can be seen that claim 1 as amended cannot be anticipated, or otherwise rendered unpatentable, in view of Oh-Yang due to Oh-Yang's use of highly-F inclusive gas to remove byproducts which is highly undesirable.

Claim 9 requires that "at least one of the second and fourth gases consists essentially of O_2." Again, the cited art fails to disclose or suggest this aspect of claim 9.

For at least the foregoing reasons, it is respectfully requested that all rejections be withdrawn. All claims are in condition for allowance. If any minor matter remains to be resolved, the Examiner is invited to telephone the undersigned with regard to the same.

Respectfully submitted,

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